Ubiquitous Physiological Monitoring of SPO_2& Heart Rate

[1]Sagar C. Chhatrala, [2]Mitul R. Khandhedia
[1]M.E. Student, [2]Asst. Prof.
[1, 2]Department Of Electronics & Communication Engineering
[1, 2]Darshan Institute of Engineering and Technology(GTU), Rajkot-363650
[1]sagar.chhatrala@gmail.com[2]mitulkhandhedia@gmail.com

Abstract—*Typically in Health Monitoring systems collect a variety of vital signs such as heart rate, blood pressure, oxygen saturation, body weight and temperature. These raw data are usually seen on the system display. Currently, there is no cost-effective wireless health monitoring system in Hospitals and thus most monitoring companies rely on phone lines to transmit data, thus the goal of constant wireless monitoring is not completely accomplished. Furthermore, recently we implement parameters of the heartbeat and Pulse Oxiometer, further we may also implement parameters such as the respiration, blood pressure (BP), signal and temperature signals.*

There has been an increasing demand in the field of care industry that vital signals need to be continuously recorded for those patients with chronic conditions such as cardiovascular disease. The recorded signals can be further analyzed to provide more detailed information about the Patient. With the help of GPRS, ETHERNET, Wi-Fi, etc. Present we implement ETHERNET module and future we also include the data communication systems as GPRS and Wi-Fi. It has valuable benefit for the physician to track the status of patients and to response quickly should any changes occur in the patient's condition.

Keywords—
P.M.S. - Patient Monitoring Systems
C.P.M.S. - Centralized Pateint Monitoring Systems
R.R - Respiration Rate
I.B.P. - Invasive Blood Pressure
N.I.B.P. - Non-Invasive Blood Pressure
SPO2 - Oxygen Saturation in Human Blood
TCP/IP - Transmission Communication Protocol / Internet Protocol
ICU - Intensive Care Unit
C.C.U. - Critical Care Unit
LED - Light Emitting Diodes
LCD - Liquid Crystal Display

I. INTRODUCTION

The Patient Monitoring System (PMS) [1] is a very critical monitoring systems, it is used for monitoring physiological signals including Electrocardiograph (ECG), Respiration, Invasive and Non-Invasive Blood Pressure, Oxygen Saturation in Human Blood (SpO2), Body Temperature and other Gases etc. In PMS, the multiple sensor and electrodes is used for receiving physiological signals like as ECG Electrodes, SpO2 Finger Sensor, Blood Pressure Cuff and Temperature Probe to measure the physiological signals.

During treatment, it is highly important to continuously monitor the vital physiological signs of the patient. Therefore, patient monitoring systems has always been occupying a very important position in the field of medical devices. The continuous improvement of technologies not only helps us transmit the vital physiological signs to the medical personnel but also simplifies the measurement and as a result raises the monitoring efficiency of patients.

II. CURRENT SCENARIO [1]

In terms of functionality, the Patient Monitoring System (PMS) made up by the following modules.

A. Application Module.

B. Processing and Interface Module.

C. Power supply Module.

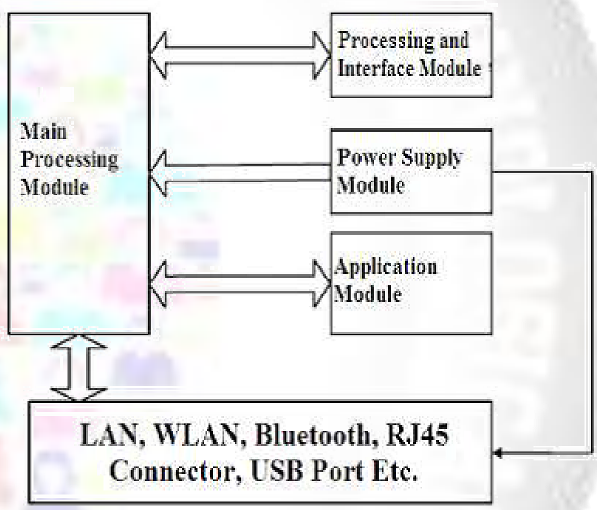

Figure 1: Schematic Diagram OfPatient Monitoring System (PMS)

A. *Application Module.*

In this module data collect from the probe and that analog signal give to the processor.

B. *Processing and Interface Module.*

Here in processing unit analog data coming from the probe those analog signals convert in to digital form. And these digital signals given to the different modules like DISPLAY, ETHERNET, etc.

C. *Power Supply Module.*

Power supply module provides the power to entire unit of the module. By this module we operate our whole module.

D. *Disadvantages of Current Scenario*

1) More Sensors Was Required
2) Not Storage Capacity
3) No Real Time Monitoring
4) More Compatible

III. IMPLEMENTATION

A. *Block Diagram for Spo$_2$ and Heart Rate*

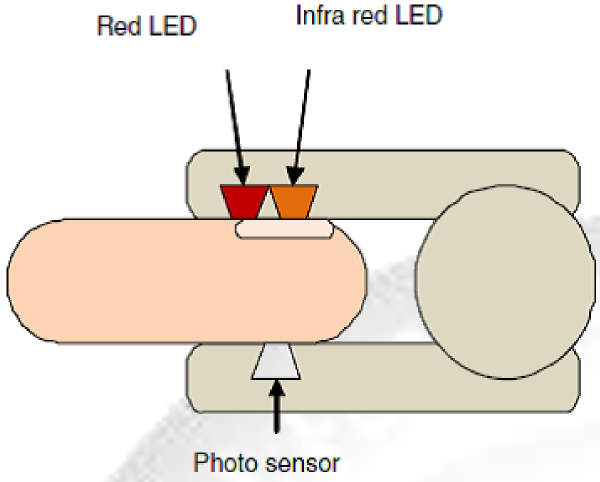

Figure 2: Detection of SPO$_2$ and Heart Rate.

For the sensors Light from two LEDs with different wavelengths i.e. 660 (RED) and940 nm (IR) are made to fall on the finger. Oxygenated haemoglobin absorbs more infrared light and allows more red lights to pass through. Deoxygenated haemoglobin absorbs more red lights and allows more infrared light to pass through. Pulse Oximetry can be done using two methods, reflectance oximetry and transmittance oximetry. Here, the light moves through the skin, muscle and blood vessel, and is reflected back from the bone. Reflectance oximetry has low signal to noise ratio and difficult to set up. In case of transmittance oximetry, the two LEDs and the photodiode are on the opposite side of the finger. Here, the transmitted light is detected by the photo diode, and is found to have higher signal to noise ratio.

The normal human heart rate ranges from 60–100 bpm. Bradycardia refers to a slow heart rate, defined as below 60 bpm. Tachycardia refers to a fast heart rate, defined as above 100 bpm. When the heart is not beating in a regular pattern, this is referred to as an arrhythmia. These abnormalities of heart rate sometimes, but not always, indicate disease.

B. *Interfacing of Probe with Arduino for SPO$_2$& Heart Rate*

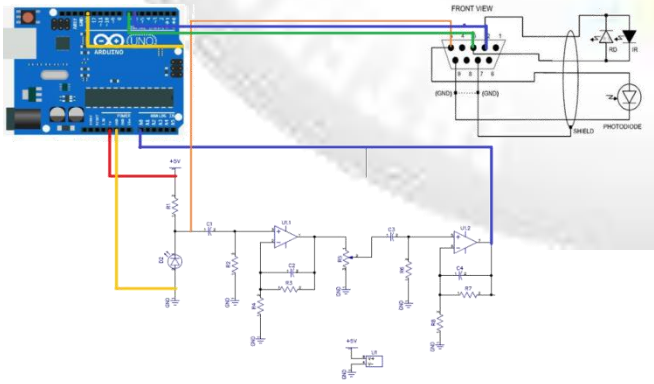

Figure 3: Interfacing Of Arduino Board with Probe

The output of the photodiode is very less in amplitude, and also very noisy. Before giving to the microcontroller (ARDUINO), high amplification and filtering is required to get the desired signal. Two band pass filters are used for the signal processing. The microcontroller (ARDUINO) is required to perform the analog to digital conversion of the signal, and calculate the peak amplitudes of the signal to generate the heart rate and SpO$_2$.

C. *Role of Filtering Circuit*

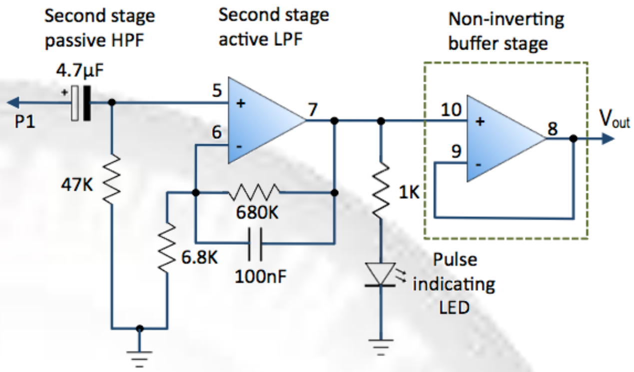

Figure 4: Filtering Circuit

In the circuit shown above, the sensor output is first passed through a RC high-pass filter (HPF) to get rid of the DC component. The cut-off frequency of the HPF is set to 0.7 Hz. Next stage is an active low-pass filter (LPF) that is made of an Op-Amp circuit. The gain and the cut-off frequency of the LPF are set to 101 and 2.34 Hz, respectively. Thus thecombination of the HPF and LPF helps to remove unwanted DC signal and high frequency noise including 60 Hz

D. *Block Diagram of Arduino [11]*

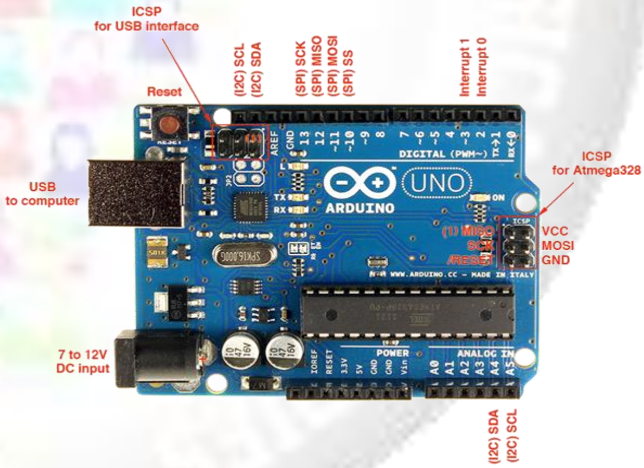

Figure 5: Arduino Board

1) An open source design.
2) An easy USB interface.
3) Very convenient power management and built-in voltage regulation.
4) A 16 MHz clock. This makes it not the speediest microcontroller around, but fast enough for most applications.
5) 32 KB of flash memory for storing your code.
6) 13 digital pins and 6 analog pins.
7) An on-board LED attached to digital pin 13 for fast an easy debugging of code.

8) And last, but not least, a button to reset the program on the chip.

E. *Arduino Interface with LCD*

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display.

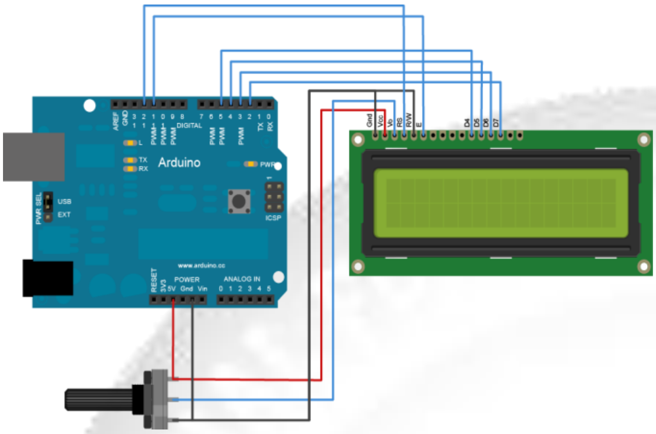

Figure 6: Arduino Interface with LCD

F. *Why Ethernet Interface used?*

This Ethernet Breakout-Module is simplest way to add LAN connectivity to your microcontroller based products and projects.

Use this module to enable Ethernet interface for your product. It works with any microcontroller operating at 3.3V or 5V.

Host web server, ping the module or add it to home automation via internet. And also give the real time monitoring.

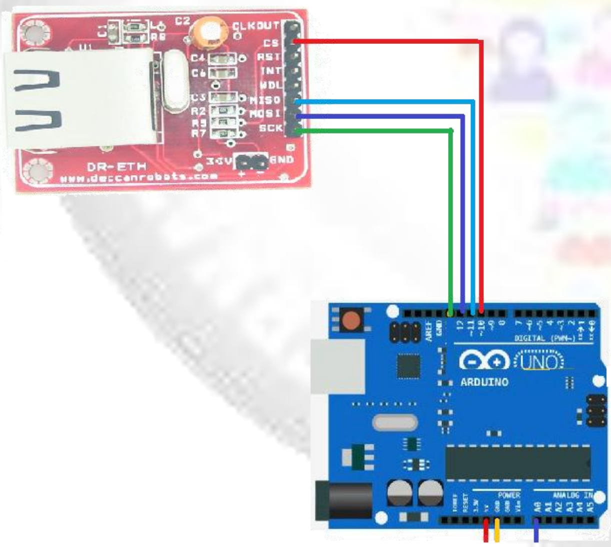

Figure 7: Connection of Arduino With Ethernet Module

G. *Data on Web Server*

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display.

This digital signals us also able to upload to the server. This data will display the real time result of patient monitoring on the display of the personal computer.

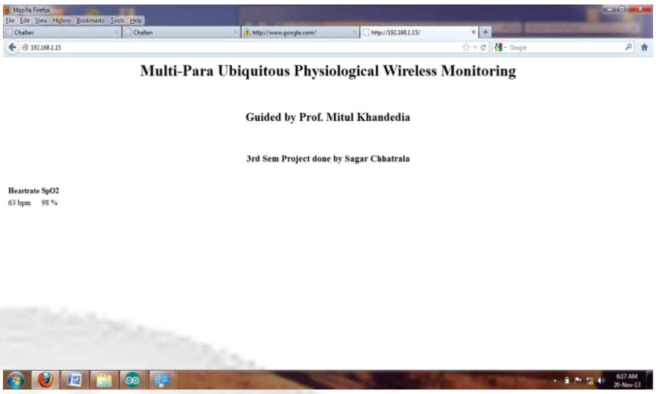

Figure 8: Result of WEBSERVER Output

H. *Advantages*

1) Minimum Number of Sensor
2) Real Time Monitoring
3) Memory Capacity
4) User Friendly
5) Easy To Operate
6) High Sensitivity

IV. RESULTS

A. *Connections*

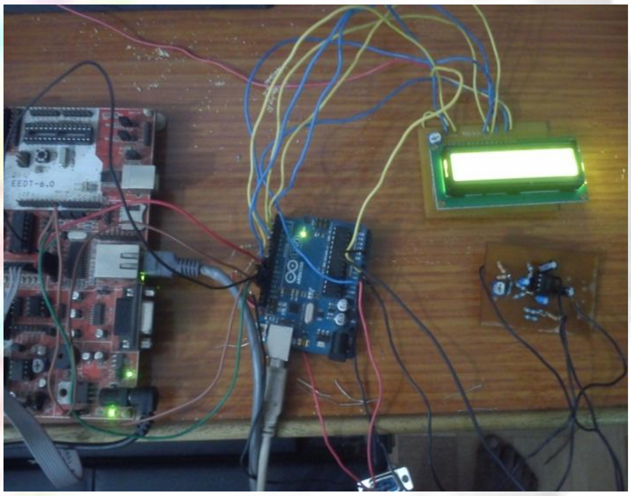

Figure 9: Connections of Probe, LCD & Ethernet with Arduino

B. *LCD Output Result*

Figure 10: Result of LCD Output

V. CONCLUSIONS

This project is giving the full details of the Arduino-UNO (Processor). Here we also get the information about how low signals are got from the finger probe. That signals we amplify and than we do analog to digital conversations of that signals. Than we take that signals from it. That signal we interfacing with our Ethernet module. And we got the real time information signals.

By this real time data we are more comfortable in monitoring the information's of patients. So this is the easy and best way to monitoring the real time patients health monitoring.

The Heart rate and SpO2 for me was on an average 80 beats per minute and 98.23% respectively. The heart rate for normal person is about 72 beats per minute and a normal range is about 60-90 beats per minute. The SpO2 for normal person lies between 95-99%. SpO2 below 94% may be fatal and may cause unconsciousness. The device was designed efficiently and met all expectations as set earlier. The current sensor probe is flexible for a thick finger more flexible.

Finally we got that, by this entire method and process we conclude that this way and method is the best and easy way for the real patients monitoring system.

ACKNOWLEDGMENT

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